H→ γγ Full Simulation

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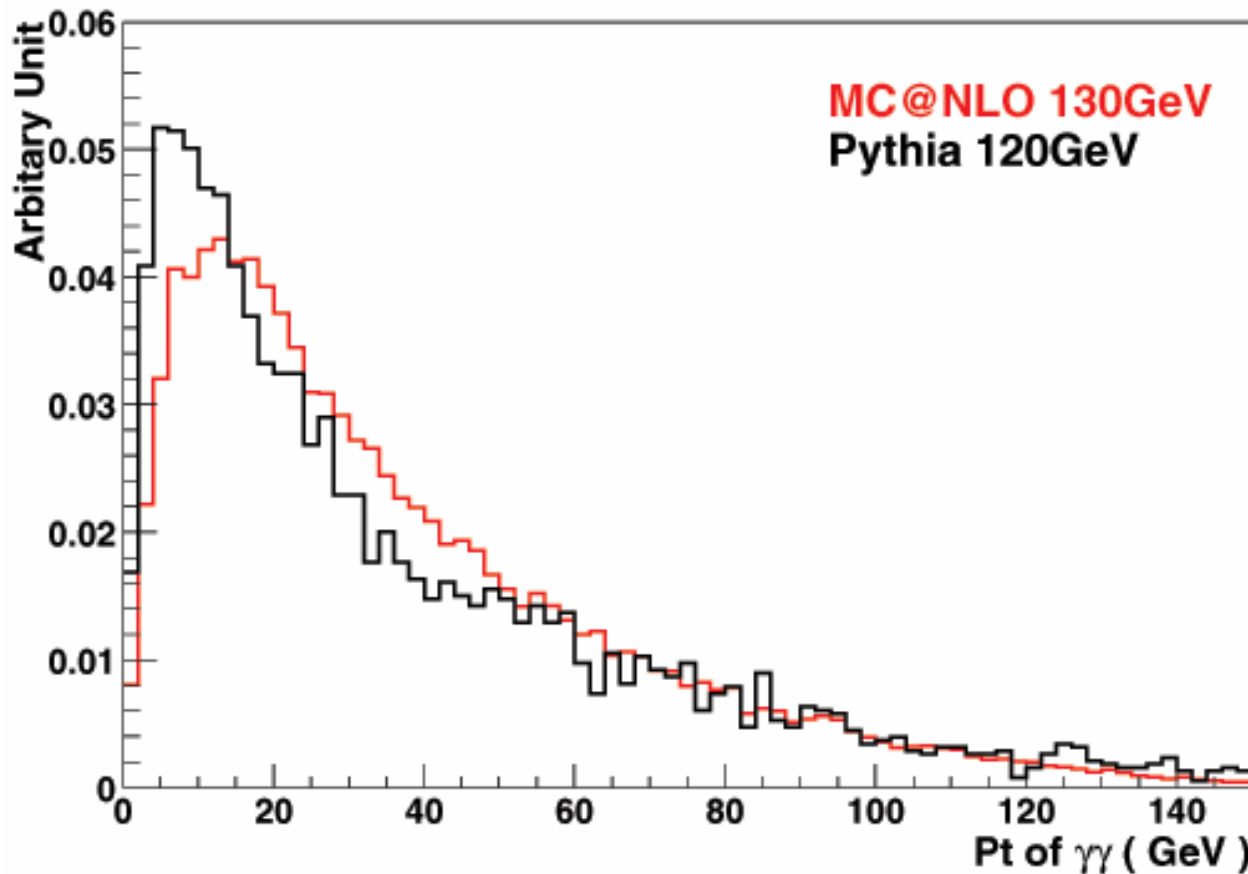
University of Wisconsin

Higgs WG meeting 07/04/04

Outline

- H→ $\gamma\gamma$: comparisons of $M_{\gamma\gamma}$, $P_{T\gamma\gamma}$ between Pythia and MC@NLO with full sim

- $M_{\gamma\gamma}$: Vertex Correction

- H($\rightarrow\gamma\gamma$)+jet: analysis comparison between full and fast Simulations

- Conclusions

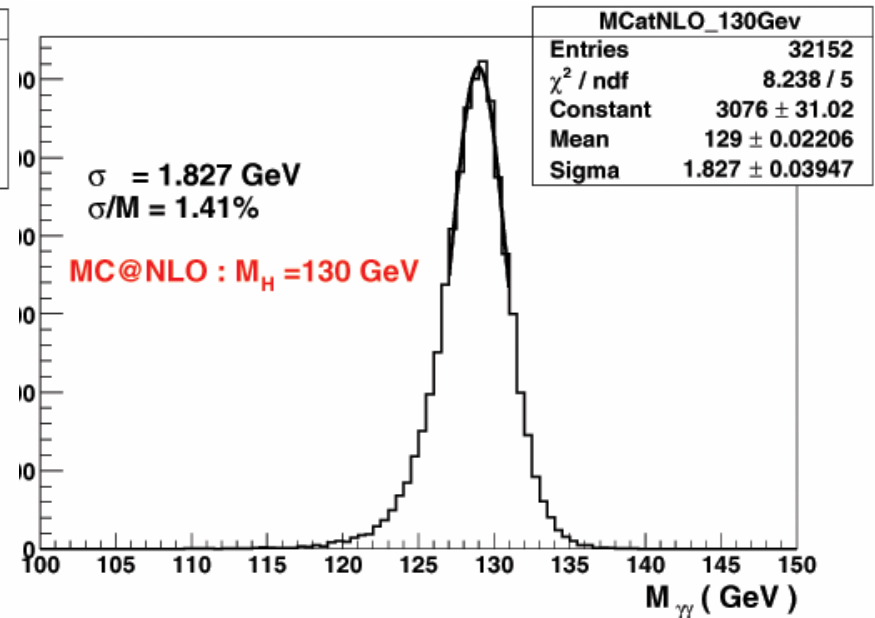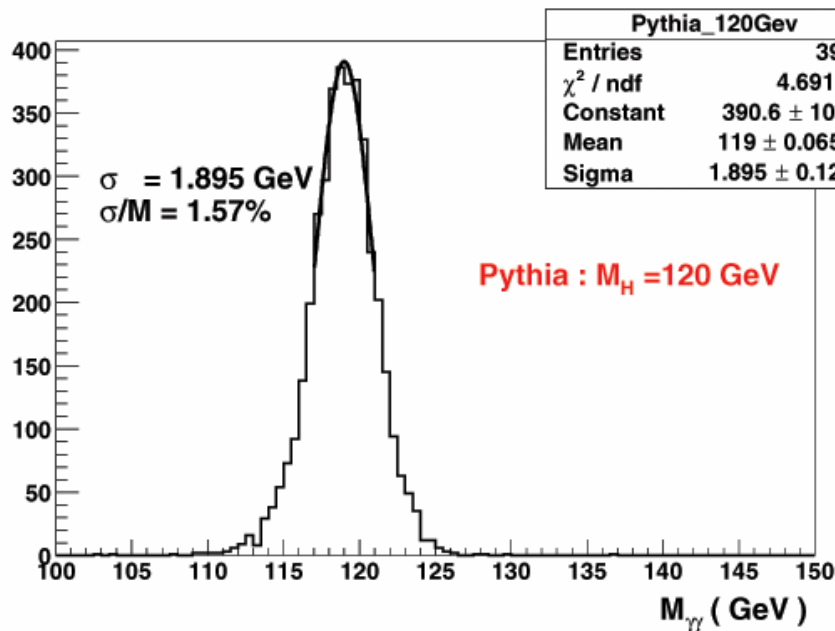# Pythia and MC@NLO

P_T of $\gamma\,\gamma$ Distribution

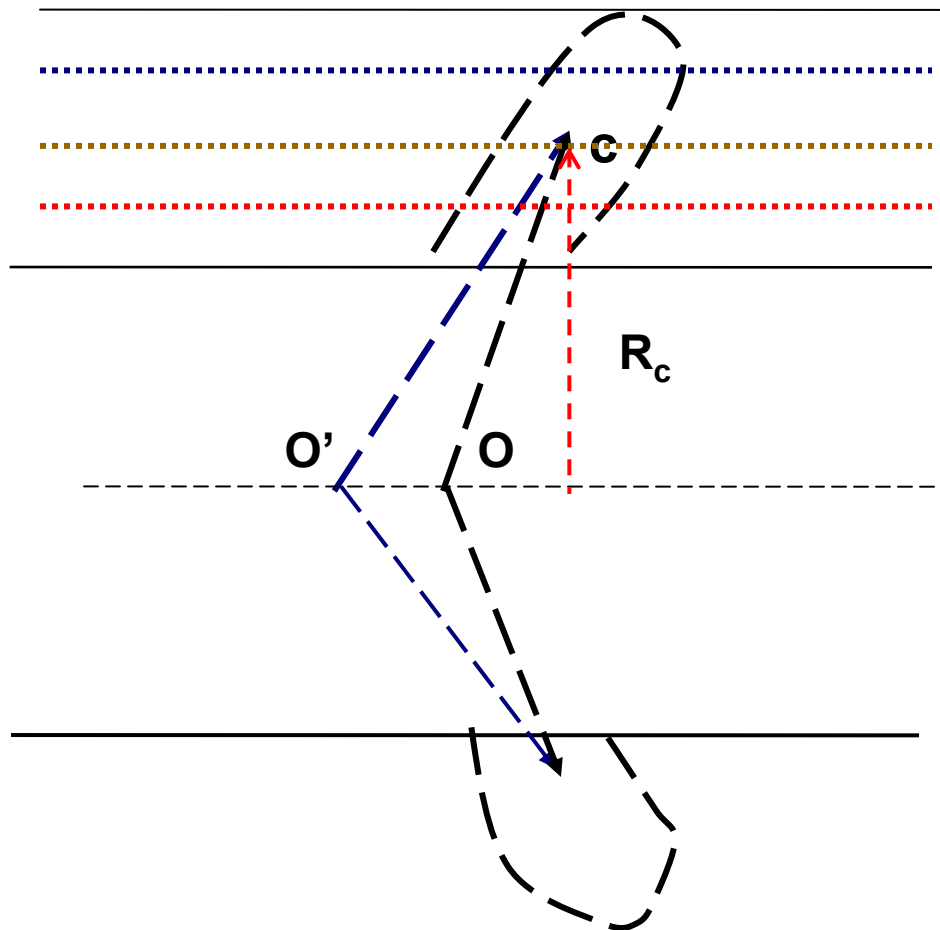Cuts applied : $P_{T\gamma 1} > 40$ GeV, $P_{T\gamma 2} > 25$ GeV,   Offline cuts for γ ID

Pythia and MC@NLO (cont)
Reconstruction of M$_{\gamma\gamma}$

No Calibrations of γ and Vertex

Vertex Correction

3 quarters in Calorimeter

Half in Calorimeter

Quarter in Calorimeter

Inner face of Calorimeter

R_c

Z: axis of the Interaction axis
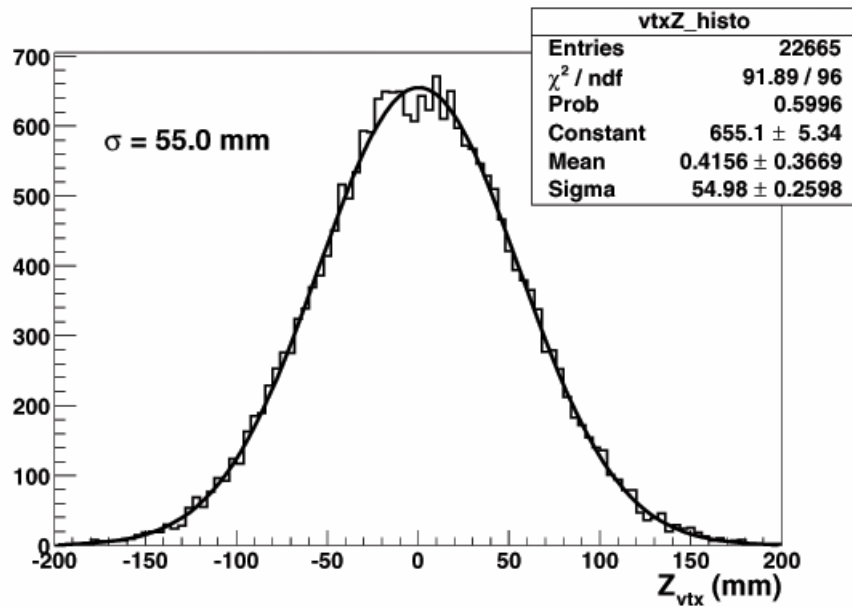
O: standard IP

O': corrected O from tracking block
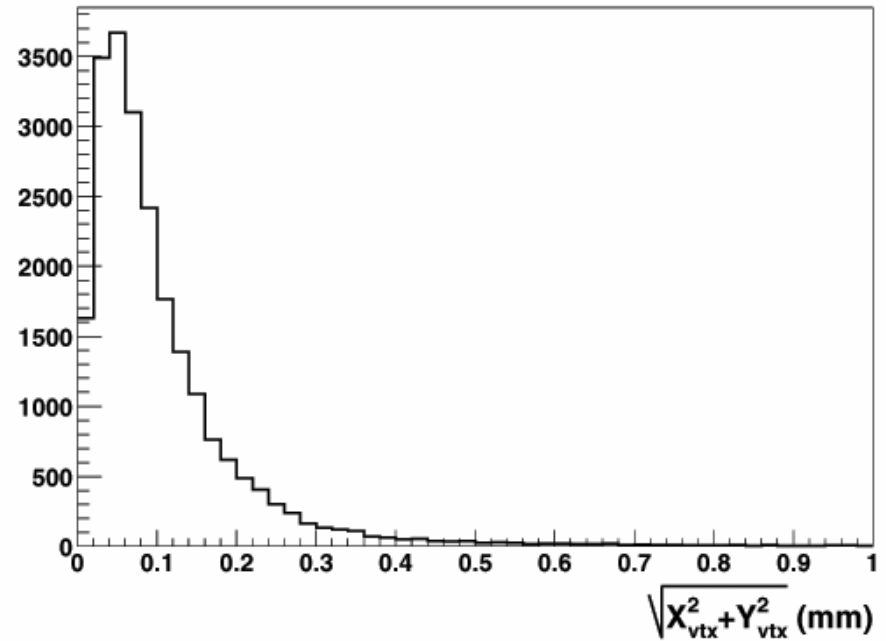
C: shower centre in calorimeter

R_C: radius of shower centre

For the time being, try different depths of shower centre.
In the future, we will use the a shower depth parametrization
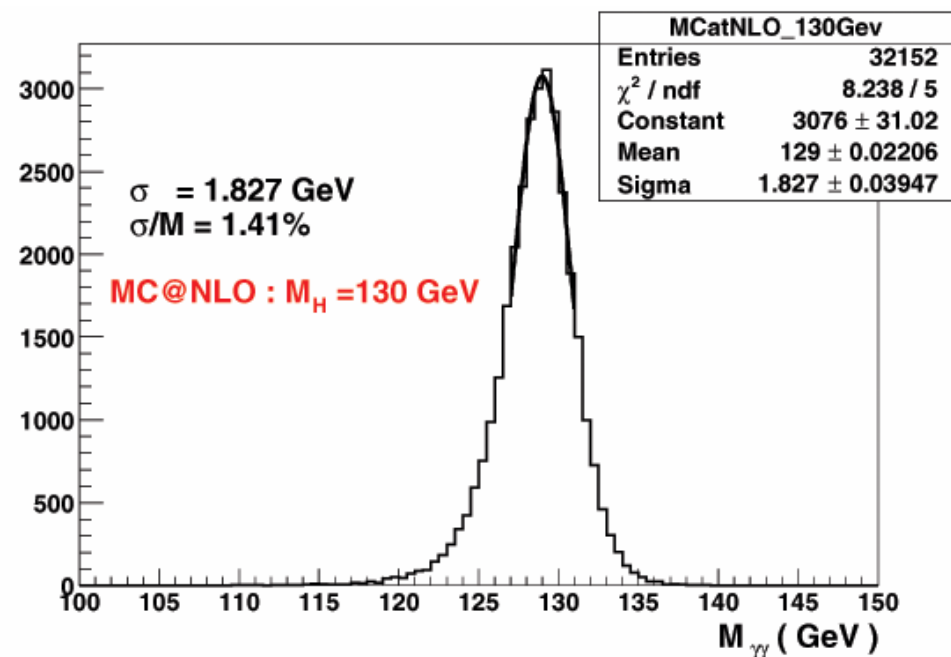
Z and R of vertex

Z vertex

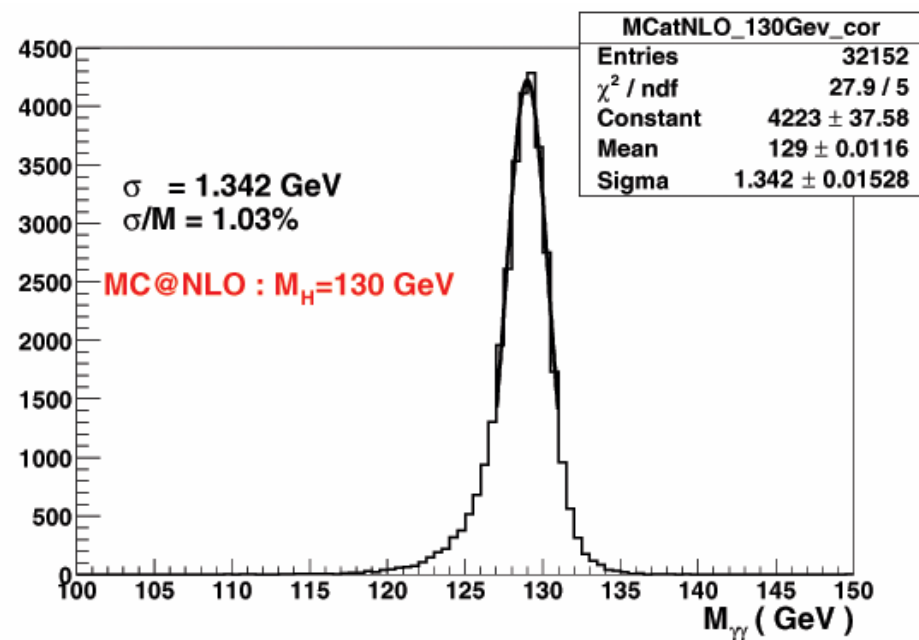R vertex

Reconstruction of M$_{\gamma\gamma}$

No calibration to the recon of M$_H$ applied

The improvement of σ is 26%

Before Vertex Correction

After Vertex Correction

MCatNLO_130Gev	
Entries	32152
χ^2 / ndf	8.238 / 5
Constant	3076 ± 31.02
Mean	129 ± 0.02206
Sigma	1.827 ± 0.03947

σ = 1.827 GeV
σ/M = 1.41%

MC@NLO : M$_H$ =130 GeV

MCatNLO_130Gev_cor	
Entries	32152
χ^2 / ndf	27.9 / 5
Constant	4223 ± 37.58
Mean	129 ± 0.0116
Sigma	1.342 ± 0.01528

σ = 1.342 GeV
σ/M = 1.03%

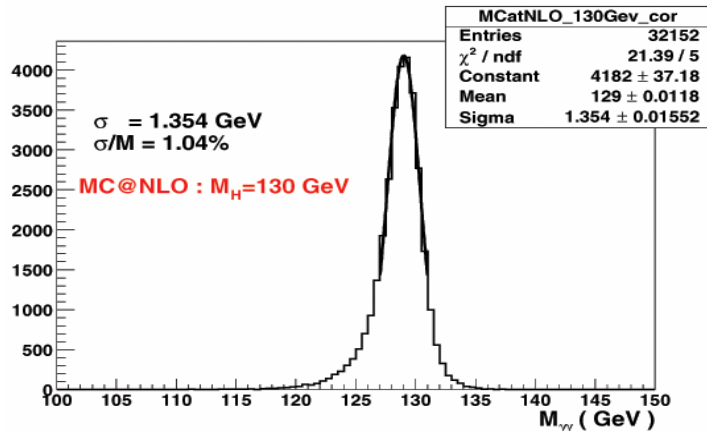MC@NLO : M$_H$=130 GeV

M$_{\gamma\gamma}$ (GeV)
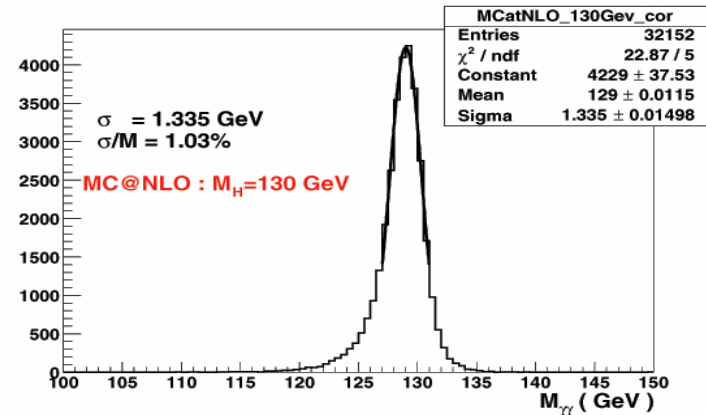
M$_{\gamma\gamma}$ (GeV)

Position of shower centre is assumed at diff. calorimeter depths

$\Delta\sigma/\sigma$ not higher than 1% , so it can be viewed as higher order correction
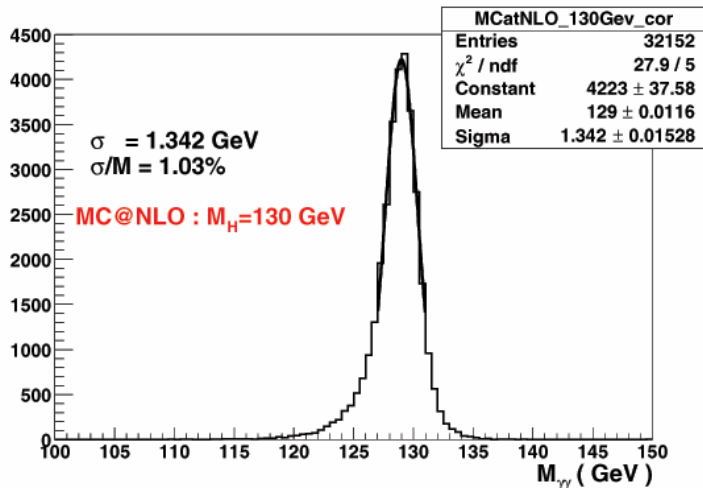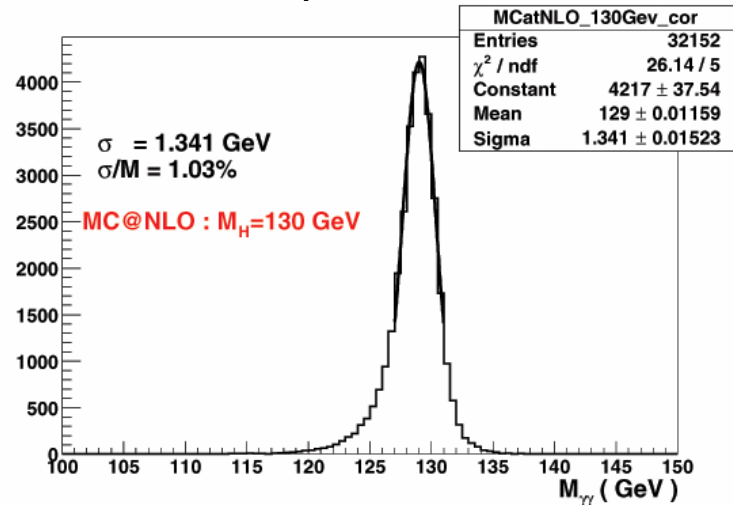
inner face

quarter

half

3 quarters

H($\rightarrow\gamma\gamma$)+jet: Full and Fast Simulation

M_H =130 GeV

MC@NLO   Athena version 7.0.2

Cuts applied:

➢ $P_{T\gamma1}$ > 50 GeV $P_{T\gamma2}$> M_H/2-15 GeV

➢ Offline Cuts for γ ID (Karina 25/9/03)

➢ P_{TJ} > 30 GeV

➢ $M_{\gamma\gamma J}$ > 300 GeV

H($\to \gamma\gamma$)+jet: Efficiency and Cross section

g g$\to$ H

	fast sim	full sim
$P_{T\gamma 1}$ $P_{T\gamma 2}$ cuts	0.36	0.36
γ ID	0.64 (set)	0.80
P_{TJ} > 30 GeV	0.36	0.35
$M_{\gamma\gamma j}$ > 300 Gev	0.47	0.51
Cross Section(fb)	2.43	3.25

Conclusions

- MC@NLO has somewhat harder $P_{T\gamma\gamma}$ and 5-10% better $M_{\gamma\gamma}$ resolution than Pythia.

- Vertex correction improves the resolution of the reconstructed M_H by 26%. The correction due to the position of centre of shower in the calorimeter can be viewed as a higher order correction.

- For $(H \rightarrow \gamma\gamma)$ + jet, efficiency of full sim is 34% higher w.r.t fast sim due mostly to γ-ID. The other cuts in Fast and full simulations give close efficiencies.